Knowledge Graphs Transform Semantic Analytics Towards A Semantic Web

What is semantic web?

Semantic web refers to a state where machines understand every piece of information available on the internet. This enables machines to process content at scale and provide meaningful insights. They are also able to represent data in a structured manner, so it can be easily connected and reused. Other foreseeable benefits of the semantic web include complete automation with intelligent self-sufficient systems, personalization on every front, and knowledge discovery, by linking new data and working on existing relationships to infer new relations, in quick time.

A common challenge that the semantic web faces is standardization of data. Without standardization, data would be available in various formats and languages. The common frameworks used to avoid this challenge include web ontology language (OWL) and resource description framework (RDF). These frameworks ensure the use of common data formats and exchange protocols on the web.

What is semantic analytics?

Semantic analytics helps us derive meaningful insights from available knowledge. Machines are able to understand text by interpreting sentences along with grammatical structures, to get a better understanding of the context that the text is referring to. The technology behind this - natural language processing (NLP) - is extensively used in building chatbots as well. Using semantic analytics, it is easy to access and draw meaningful insights from unstructured data, from various sources like emails, social media, or other legacy systems.

The word orange, for instance, has two meanings - one the colour and the other the fruit. Semantic analytics tackles this problem by identifying relationships between two entities and determining which meaning would fit better in the given context. A common semantic analytics model is sentiment analysis, where we try to decipher the emotion in a text. Based on the sentiment score, it is possible to define whether a text is delivering a positive, negative, or neutral sentiment. This model is very helpful in evaluating overall sentiments on any topic by analyzing tweets related to them.

Semantic analytics is commonly used to classify texts based on predefined categories. Take the case of support tickets - people often raise tickets in wrong categories and agents have to spend a lot of time assigning them to the correct department. This problem can be easily solved by using semantic analytics, as tickets can be sorted based on their content. Intent classification is also very well used to sort data points, based on a person's interest.

What is a knowledge graph?

A knowledge graph can be referred to as a computer's encyclopaedia. Information is stored in an organized way that a machine can understand and refer to. Using knowledge graphs, a relationship can be created between two entities based on their attributes. One of the most common use cases of knowledge graph is the Google search engine. It is powered by Google's knowledge graph, which is often referred as "The Knowledge Graph". The search engine provides the right search results even if we type two or three words in Google search. This happens because the knowledge graph analyzes what each word means in a search, rather than analyzing the entire string.

Knowledge graph stores information in a way that is similar to how we remember things and the relationships between them. For example, we might remember two common friends by considering a link between one friend and his/her friend. The only difference between a machine and humans is that we tend to forget and mix things up. But once a machine gets a relationship right, it stores it and never forgets it. We've often heard about metadata, that is, the description of data. The links between entities is also based on metadata and it lays a foundation for the knowledge graph. If we visualize a knowledge graph, it will look like a complex network where each entity is linked to the other based on some entity description.

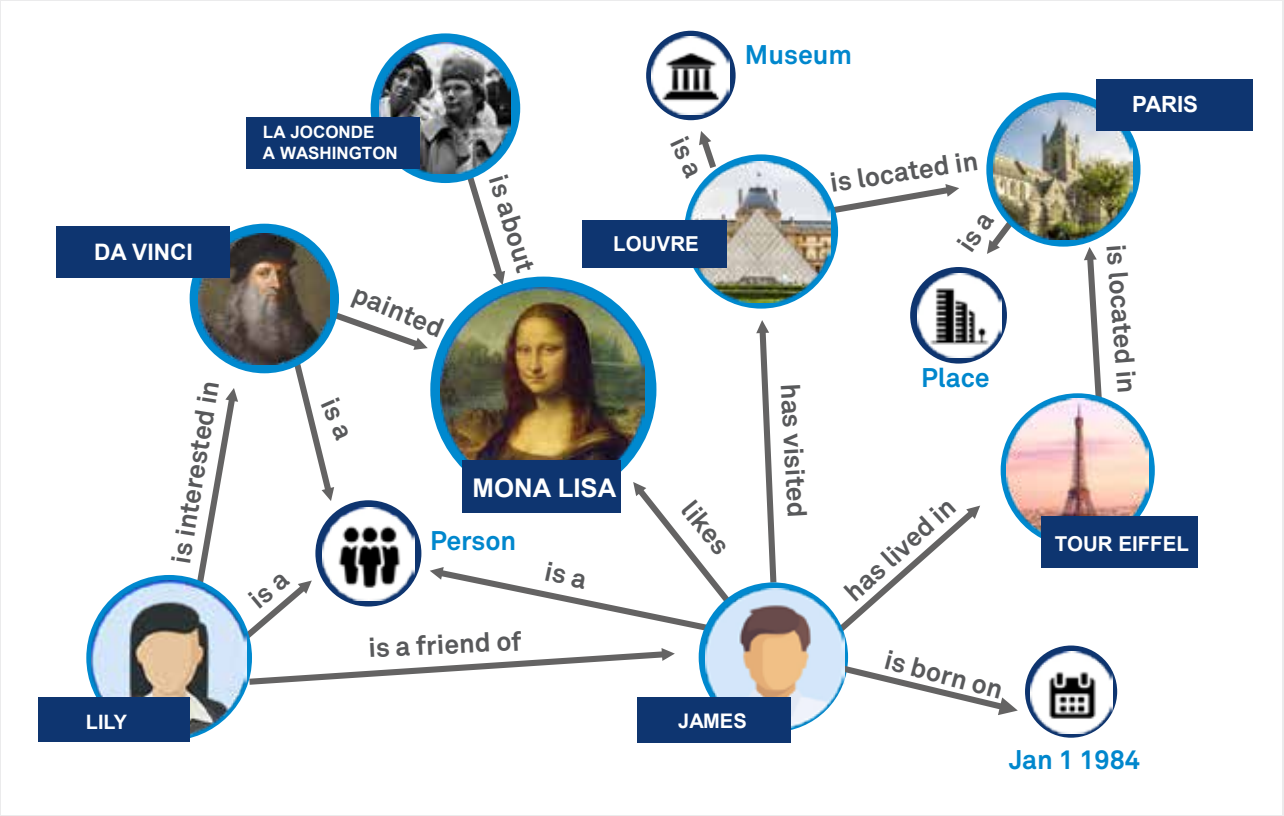

Figure 1: How knowledge graphs build relationship within entities

To simplify, let's take an easy to understand example. In the above diagram, we can see that each entity is linked to another with some attributes. Let's assume that using different sources we were able to find that James lives in Paris and likes Mona Lisa. The semantic web can draw various inferences using all the information available on the web, like James' friends and DOB, as shown above. If any new entity is found that relates to this knowledge graph, it can be easily added and can connect to every other entity. Google search algorithms also use knowledge graphs to yield accurate search results even when merely two or three words are written. It automatically infers how these terms are connected and what t hey mean.

Knowledge graph and machine learning

Once a huge knowledge graph is built, the next step is to utilize the knowledge to train models with high accuracy. Machine learning and knowledge graphs work well together as machine learning gets better at working on data sets by improving precision and recall, while knowledge graphs get better at representing and explaining network entities and relationships. Both the systems benefit when they're used together. Some of these benefits are discussed below:

- **Improved data sets :** To train models using machine learning, we need enough data to generate meaningful models. Since data is not always in a complete state, and incomplete data is often removed, it results in small sets and models that are not completely accurate. Knowledge graphs can be used to fill out incomplete data using similar entities and data to generate models with high accuracy and precision. Also, in case of unsupervised learning Knowledge graphs helps find new insights and also easily help explain the cause of that insight.

- **Understandable insights :** Models often give predictions that have no solid explanations. The main cause behind this issue is representation. Knowledge graphs help to link this inability to explain to proper data sets in the graph, thus removing ambiguity and enhancing the entire decision-making process. Knowledge matching helps identify hidden layers and predict outputs based on deep models that are mapped back to the entities of the knowledge graph, based on their relations.

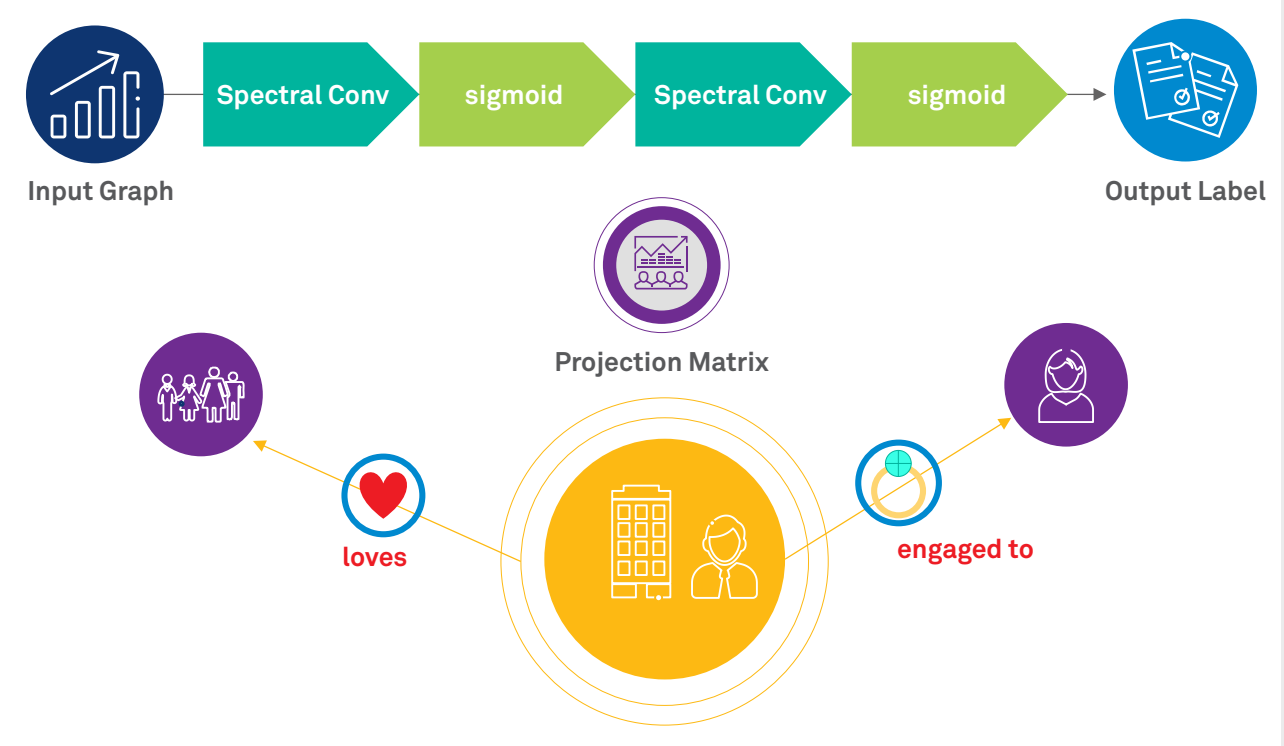

Figure 2: How entity vector is used to define label between entities

Spectral analysis of graph is majorly used for unsupervised learnings and for tasks like clustering and discovery. In the Figure 2, we can see that how a projection matrix is used is used to define relation of entity vector with other entities.

Let us discuss some use cases to understand knowledge graphs better. Research is one of the most time consuming and important activity for any project. The medical industry is dependent on a lot of scientific literature and accessing such data repeatedly can be tedious. Knowledge graphs are used to store information in a systematic way, which can then be utilized for future researches. Recommendation engines use knowledge graphs extensively to create personalized lists of offerings for every individual. Organizations are realizing the benefits of knowledge graphs in the logistics industry, where they can be used to track movement, personnel, inventory, etc., and bring agility to the entire system.

High value use cases of knowledge graphs

1. Financial analytics:

Banks can utilize this technology to help with credit analysis. They can connect organizations with their suppliers and vendors to ensure credibility and determine if there are any problems going on within an organization that could affect their loan repayment. Also, financial news can be linked with entities to ensure market intelligence is being used to determine a company's financial status. Knowledge graphs can also create an investment map for investor companies to show how they are co investing with other companies. It can also be used to locate companies that are working with their competitors.

2. Customer relationship management

Companies often struggle to benefit from their customer data, as the data is usually stored across various departments. The customer data is available in diverse formats, and often different systems create unique identifiers making it almost impossible to map customer data and find meaningful insights out of it. By using knowledge graphs, organizations can create a centralized data house that can link data from all departments and help create relationships on a need basis, as new problems arise.

3. Healthcare and life sciences industry

The life sciences industry requires a lot of literature, to review, study, and infer insights. There is no formal way to store this research material, so it can be used whenever required.

Drug discovery is one of the most important issues in today's post COVID-19 world. Knowledge graphs can extract meaningful insights from structured or unstructured literature/research. It doesn't end here; graphs can also help trace information to support your findings. The graph is useful in training models that can identify patterns and correlations between chemical structures.

Healthcare companies can draw major benefits by deploying knowledge graph based solutions like Ontotext, to improve discoverability of insights using unstructured data, stay ahead of competition by utilizing market intelligence, and boosting knowledge sharing and medical coding for electronic health records.

Knowledge graphs provide a new and effective way to handle data in a systematic and standard format. Reusability of data is another challenge that knowledge graphs solve. They are a vital tool leading us to the semantic web, where machines are more powerful that humans and can generate results even before humans can think about them. Humans work with limited knowledge. But with the help of the semantic web, we can utilize knowledge that we aren't yet aware of.

About the authors

Vartul Mittal

Vartul Mittal is a technology and innovation specialist focused on helping clients accelerate their digital transformation journeys. He has 14+ years of global business transformation experience in management consulting and global in-house centers, in managing technology and business teams in intelligent automation, advanced analytics, and cloud adoption. He is passionate about extending customer relationships beyond the project level, to transform enterprise operations, and increase business value.

Shrinkhal Gupta

Shrinkhal Gupta leads transformation go-to-market activities for iCORE, Wipro Limited, with a special focus on virtual and industry events. He also leads growth marketing activities and demand generation initiatives for automation and new age SaaS platforms and solutions for Wipro's global clients.

Wipro Limited
Doddakannelli, Sarjapur Road,
Bangalore-560 035,
India

Tel: +91 (80) 2844 0011
Fax: +91 (80) 2844 0256
wipro.com

For more information,
please write to us at
info@wipro.com

IND/B&T/JAN2019-JUN2019

Wipro Limited (NYSE: WIT,
BSE: 507685, NSE: WIPRO) is
a leading global information
technology, consulting and
business process services
company. We harness the
power of cognitive computing,
hyper-automation, robotics,
cloud, analytics and emerging
technologies to help our
clients adapt to the digital
world and make them
successful. A company
recognized globally for its
comprehensive portfolio of
services, strong commitment
to sustainability and good
corporate citizenship, we
have over 180,000 dedicated
employees serving clients
across six continents.
Together, we discover ideas
and connect the dots to
build a better and a bold
new future.

For more information,
please write to us at
info@wipro.com

IND/INT-EOT/MAR2021-FEB2022