White Paper

Powering Recommendations with a Graph Database

Jim Webber

Chief Scientist, Neo4j

White Paper

TABLE OF CONTENTS

"You May Also Like..." 2
Graph Databases: An Uncontroversial Choice 3
Business Benefits of Neo4j 3
Walmart and Other Leading Adopters 4
Trying Out Neo4j 5

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– Voker Pacher, Senior Developer eBay

Powering Recommendations with a Graph Database

The Business Benefits of Providing Real-Time Recommendations

JIM WEBBER, CHIEF SCIENTIST, NEO4J

"You May Also Like..."

Product recommendations help businesses maximize their online revenue. It requires advanced technology, but this is now available off the shelf and is already being used by Walmart and other market leaders.

"You may also like" is a deceptively simple phrase that encapsulates a new era in customer relationship management. In offering tailored suggestions, businesses maximize the value they deliver by providing highly targeted, real-time product recommendations to their online consumers.

This ability to make compelling offers requires a new generation of technology. That technology must capture the customer's buying history and also instantly analyze their current choices, before immediately matching them to the most appropriate product recommendations. And all of this analysis must be done in real time before the customer moves to a competitor's website.

The key technology in enabling real-time recommendations is the graph database, a technology that is quickly leaving traditional relational databases (RDBMS) behind.

Graph databases easily outperform relational and other NoSQL data products for connecting masses of buyer and product data (and connected data in general) to gain insight into customer needs and product trends.

Significantly, graph databases are a core technology platform of internet giants like Google, Facebook and LinkedIn. But while those pioneers had to build their own in-house data stores from scratch, off-the-shelf graph databases – especially Neo4j – are now available to any business wanting to make the most of real-time recommendations.

The profit and productivity improvements graph databases offer over relational systems are astounding. Volker Pacher, Senior Developer at eBay which uses the Neo4j graph database said: "We found Neo4j to be literally thousands of times faster than our prior MySQL solution, with queries that require 10-100 times less code. Today, Neo4j provides eBay with functionality that was previously impossible."

"Neo4j helps us to understand our online shoppers' behavior and the relationships between our customers and products, providing a perfect tool for real-time product recommendations. As the current market leader in graph databases, and with enterprise features for scalability and availability, Neo4j is the right choice to meet our demands."

– Marcos Wada, Software Developer Walmart

Graph Databases: An Uncontroversial Choice

eBay is not alone in selecting an off-the-shelf graph database like Neo4j as a core platform for business-critical systems. Neo4j is the world's most popular graph database, according to database monitoring site DB-Engines. Graph databases are growing in popularity faster than any other type of database – by around 250% since last year alone. The DB-Engines authors noted excitedly that "graph databases are grabbing an ever-larger slice of developers' attention. If you haven't used them yet, perhaps it's time to have a closer look."

The key to understanding graph database systems is that they give equal prominence to storing both the data (customers, products, categories) and the relationships between them (who bought what, who "likes" whom, which purchase happened first). In a graph database, you don't have to live with the semantically poor data model and expensive, unpredictable JOINs from the relational database world.

Instead, graph databases support many named, directed relationships between entities (or nodes) which give a rich semantic context for the data. Now we can specify both `loves` and `married to` a spouse, `owns` and `dislikes` a game console, or repeatedly `visited` a store that was amazing. And queries are super-fast since there is no JOIN penalty.

This makes graph databases especially suited to formulating recommendations, because making the best recommendations – and maximizing value – involve more than simply offering products because they are best sellers. Best sellers can be a successful part of a recommendation, but they are one which by their nature are an aggregate picture of all customers. Nowadays customers expect finely-tuned recommendations in the long tail and they react poorly to one-size-fits-all suggestions.

Real-time recommendations require the ability to understand the customer's past purchases, quickly query this data, and match the customer to the people who are the closest match to them both in their social network and in buying patterns. To make real-time recommendations also requires the ability to instantly capture any new interests shown in the customers' current visit. Matching historical and session data like this is trivial for Neo4j.

Business Benefits of Neo4j

Companies from around the globe have incorporated Neo4j into their data architecture to take advantage of the powerful real-time recommendations the graph database provides. These enterprises have experienced a variety of business benefits as a direct result.

Improved Competitiveness

Neo4j enables new types of business functionality that are often not possible with other technologies, allowing you to make real-time decisions based on connected data. For example, Walmart uses Neo4j to make real-time product recommendations by using information about what users prefer. Additionally, most of the top dating and online job sites use Neo4j to recommend jobs or dates by incorporating a knowledge of the extended network (friends-of-friends) into the recommendation, again in real time, substantially improving the accuracy of the recommendation.

Reduced Project Time, Competitiveness and Cost

Neo4j cuts the overhead on many types of projects, particularly those involving connected data. Many customers cite the huge acceleration that occurs when a graph model is brought to bear on a connected data problem. For example, eBay cites that with Neo4j it requires 10-100 times less code than it did with SQL, and Telenor, one of the world's top telecom providers, uses Neo4j for the authorization system on its business customer portal, improving performance by 1,000 times.

"The graph database allows us to explore new connections between people, giving a very personalized experience of products we think they'll love."

– Andy Rosenbaum, Vice President Colbrain

Faster Product Time to Market and Better Performance

Neo4j requires developers to produce less code than RDBMS alternatives. Less code means higher quality and an increased success rate on projects. Neo4j's performance is dramatically better for connected datasets – often the difference between something being possible and not possible. eBay cites that "Neo4j allowed us to add functionality that was previously not possible". Many customers experience improvements on a similar scale, so much so that Neo4j is often described as decreasing query times from "minutes to milliseconds" for connected data queries.

Walmart and Other Leading Adopters

The following business are market leaders who are using Neo4j to serve up real-time recommendations in areas such as retail, industrial spare parts, jobs, movies, entertainment, restaurants and even online dating.

- Walmart calls Neo4j "a perfect tool for real-time product recommendations." The retailer has sales of more than $482 billion and employs 2.3 million associates worldwide, serving more than 260 million customers weekly through its 11,500 stores in 28 countries and ecommerce websites in 11 countries.[1] Walmart Software Developer Marcos Wada explained: "Neo4j helps us to understand our online shoppers' behavior and the relationship between our customers and products, providing a perfect tool for real-time product recommendations. As the current market leader in graph databases, and with enterprise features for scalability and availability, Neo4j is the right choice to meet our demands."

- A leading movie recommendation website is revolutionizing the way the film industry promotes projects by enabling fans to discover the best upcoming releases before they hit the big screen and make recommendations based on individual taste. In turn, it provides movie studios with insights into the preferences and behavior of film fans, enabling them to more effectively target their marketing campaigns. They considered MySQL for its recommendation system, but after seeing the amount of data required, they looked at other databases and chose Neo4j. Their CTO said: "We wanted to quickly connect audiences to the right movies, and Neo4j just fits our philosophical standpoint. We are very happy that we discovered Neo4j. We increased the speed of generating recommendations and users to movies, which is a core part to our business model."

- Cobrain makes personalized shopping recommendations to consumers from the products offered by more than 300 major apparel merchants. Members spend a few moments telling Cobrain what they like. It then uses Neo4j to make billions of calculations in order to find the products loved by their anonymous cohorts and provide real-time recommendations. Cobrain's Vice President of Engineering an Technology Andy Rosenbaum said: "The graph database allows us to explore new connections between people, giving a very personalized experience of products we think they'll love."

- eBay uses the delivery coordination platform Shutl to make the delivery of online and mobile orders quick and convenient. This eliminates the biggest roadblock between retailers and online shoppers: the option to have your item delivered the same day. Switching from MySQL to Neo4j allowed the fast-growing service to quickly match orders with couriers with relatively constant performance, and in a data model that allows queries to remain localized to their respective portions of the graph. "We achieved constant query performance by using Neo4j to create a graph that is its own index. That's awesome development flexibility," said Pacher.

1. http://corporate.walmart.com/our-story

Whether it's providing same-day delivery, real-time online product recommendations, or offering a powerful price-comparison tool, Neo4j and the real-time recommendations it affords is a driving force of success.

- The adidas Group has a global audience and wanted to step up its game by offering a personalized experience to its online shoppers. Yet, as with many large retailers, adidas was beset by a wide array of information silos, including data about products, markets, social media, master data, digital assets, brand content and other key areas. With Neo4j, the company was able to develop a "Shared Metadata Service" that allowed them to eliminate data silos and build a recommendation engine to offer relevant, real-time suggestions to shoppers across online, social and mobile channels.
- Wobi is a price comparison website for pensions and insurance that uses detailed financial pictures of customers to provide the best "value offers" to users. To achieve such a detailed level of customer understanding, Wobi needed a single customer database where it could rapidly drill-down into each individual's history and add new information on the fly - which is exactly the model that Neo4j provides. Neo4j is currently handling half a million customers with an average of eight pensions and insurance policies and products each – a total of 4 million nodes and 30 million relationships. It has the capacity to expand much further. According to Shai Bentin, Chief Technology Officer at Wobi, "It's not a large database yet – but it will be. And I feel safe with Neo4j."
- An international Fortune 500 company adopted Neo4j to power its real-time pricing recommendation engine after running into significant slow-downs with its prior database architecture. Since working with the graph database, Neo4j has significantly reduced request processing time as well as the company's hardware requirements, and performance has improved so substantially that they have seen a 300% growth in the volume of generated price changes.

Trying Out Neo4j

Neo4j is used by thousands of companies around the world, including more than 50 of the Global 2000 such as eBay, Walmart, Hewlett-Packard and Cisco. These companies have all recognized the value in - and necessity of - finding and leveraging connections between data for a variety of uses that ultimately provide customers with better user experiences.

Whether it's eBay providing customers with more seamless same-day delivery, the adidas Group offering accurate real-time product recommendations, or a well-known Fortune 500 company providing a more powerful price-comparison tool, Neo4j and the real-time recommendations it provides are a consistent driving force of success.

Ready to see what Neo4j can do for your company? Learn how to master the emerging world of graph databases by reading the free ebook O'Reilly's Graph Databases, have your development team take Neo4j for a spin, and explore the variety of available online training options to get up and running with Neo4j in no time.

Neo Technology is the creator of Neo4j, world's leading graph database. Neo4j is a highly scalable native graph database that leverages data relationships as first-class entities to help companies build intelligent applications that meet today's evolving connected data challenges including fraud detection, real-time recommendations, master data management, network security and IT operations.

Enterprises like Walmart, UBS, Cisco, HP, adidas and Lufthansa and hot startups like Medium, Musimap and Glowbl rely on Neo4j to harness the connections in their data.

UK	uk@neotechnology.com
France	ventes@neotechnology.com
Nordics	nordics@neotechnology.com
DACH	vertrieb@neotechnology.com
Southern Europe	southern-europe@neotechnology.com

info@neotechnology.com