

Graph Data Science

Use Case Selection Guide



The Rise of Graph Data Science

80%

of data and analytics innovations will use graph technologies by 2025.

*Gartner, Inc.

Graph data science has emerged as a transformative approach to easily discover data connections and relationships.

Data scientists need to deliver quick and accurate answers to complex questions so business leaders can make decisions with confidence. Graph data science combines analytics and ML to deliver these answers in seconds by connecting relationships across petabytes of data while using a wide array of graph algorithms.

The following examples demonstrate why graph data science is a smarter way to analyze data to improve predictions.

*Top 10 Trends in Data and Analytics, 2021, Gartner, Inc

Graph Data Science Use Cases For Every Department

Finance

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[Resource Allocation](#)

[Churn Prediction](#)

Marketing

[Funnel Optimization](#)

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Customer Service

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Finance

Fraud Detection

70% of organizations experiencing fraud reported that the most disruptive incident came via an external attack or collusion between external and internal sources.

CHALLENGE

Businesses must be proactive and move quickly to combat fraud – which they're facing not just from outside threats, but also from employees, customers, and partners – and it's increasing at an alarming rate.

WHY GRAPH DATA SCIENCE

Analyzing transaction data as a graph makes it easier to identify anomalies that indicate fraud, fraudsters, and fraud rings. Community detection algorithms identify unusual patterns and groupings, while centrality and similarity algorithms are used to spot suspicious users and transactions.

BENEFIT

The ability to detect fraud in real time can save millions of dollars. By identifying criminals and providing evidence to law enforcement, businesses help hold fraudsters accountable.

SUPPORTING GRAPH ALGORITHMS

Centrality

Community Detection

Similarity

Graph Embeddings

Pathfinding

Link Prediction

Similarity

Supervised ML

NEO4J GRAPH DATA SCIENCE

Native Python client

Graph-native ML pipelines

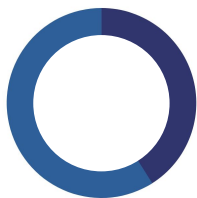
65+ pretuned algorithms

30+ connectors, extensions, and drivers

Works with your data ecosystem

Scale to hundreds of billions of nodes and relationships

Resource Allocation



44%

of CFOs cite data-driven decision-making as a top priority.

CHALLENGE

Every organization faces the onerous task of creating budgets and making decisions about what to fund, despite uncertainty around the impact of those allocations.

WHY GRAPH DATA SCIENCE

Analyzing resources in a graph helps find correlations that would not be apparent from typical backward-looking, siloed reports. Similarity and community detection algorithms highlight correlations, while centrality pinpoints critical resources, and graph machine learning approaches like link prediction help identify where certain resources could be used or adapted for new business goals.

BENEFIT

By modeling the connections between costs and objectives as relationships, you can make dynamic predictions that allow CFOs to make informed decisions with a higher degree of conviction and accuracy.

SUPPORTING GRAPH ALGORITHMS

[Centrality](#)

[Community Detection](#)

[Link Prediction](#)

[Similarity](#)

Supervised ML

Graph Embeddings

Pathfinding

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Churn Prediction

Only **1/26** unhappy customers complain, the rest simply churn.

While **11%** of customer churn could be avoided if the business simply reached out to the customer.

CHALLENGE

Predicting churn requires analysis of existing customer journeys. Most organizations do not have enough insight into customer journeys to predict which customers may churn.

WHY GRAPH DATA SCIENCE

Representing complex customer journeys as a graph helps data scientists identify the customers most prone to churn. Similarity algorithms find customers who have similar behaviors to those who previously churned, and supervised machine learning enables you to predict what actions to take to reduce churn.

BENEFIT

Retention drives repeat revenue. By identifying vulnerable points in the customer journey, you can strategize ways to intervene and salvage the customer relationship.

SUPPORTING GRAPH ALGORITHMS

[Similarity](#)

[Supervised ML](#)

[Graph Embeddings](#)

[Node Classification](#)

[Centrality](#)

[Community Detection](#)

[Pathfinding](#)

[Link Prediction](#)

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Marketing

Funnel Optimization

Optimized marketing efforts can lead to a
15-20% *lift in marketing ROI.*

CHALLENGE

Finding the optimal mix of content, brand, and product marketing investments is challenging because not all efforts have directly measurable outcomes.

WHY GRAPH DATA SCIENCE

Graphs explicitly model the rich, interconnected nature of marketing data. Neo4j Graph Data Science allows analysis using centrality algorithms to calculate the importance of each marketing touchpoint.

BENEFIT

Knowing the importance of each marketing touchpoint makes it easy to understand where to invest resources and where not to, improving ROI.

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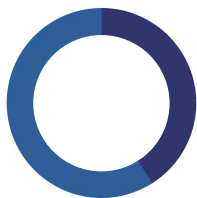
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Customer 360



47%

of recently created data records have at least one critical error.

CHALLENGE

Maintaining a database of customer records is critical for optimizing marketing campaigns, but partial and duplicate records make it difficult to get a clear picture of customers.

WHY GRAPH DATA SCIENCE

Graph data science helps you create a single, complete, customer record with community detection and similarity algorithms that link partial records together via traditional identifiers (name, address) along with customer behaviors and actions.

BENEFIT

Having a clear, accurate view of the customer enables more targeted marketing spending, ensuring that dollars are well used.

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Market Segmentation

Segmented email campaigns can lead to

14.31% *higher*

open rates than non-segmented campaigns.

CHALLENGE

Segmentation by customer demographics, interests, and behaviors is important for spurring new sales in new ways. This requires finding effective ways to identify similar customers.

WHY GRAPH DATA SCIENCE

Customers with similar behaviors and interests make up a community. While some communities are easy to identify, others are harder to identify without a graph. Graphs allow you to identify untapped market segments hiding in your data based on community interaction patterns with algorithms like community detection.

BENEFIT

Detecting communities of customers within your data makes your marketing more effective. Fresh approaches to segmentation can lead to big marketing wins.

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Influencer Identification

While **90%** of brands believe influencers are effective, only **22%** believe identifying them is easy.

CHALLENGE

Marketing departments can build credibility and increase engagement through influencers – but how can they know who would be the best influencer?

WHY GRAPH DATA SCIENCE

Companies can use their own sales data to identify the biggest buyers in each segment, alongside a dataset from any social media platform to assess buyers' social reach and the communities in which they are popular. Community detection and centrality algorithms make it possible to find your most highly connected buyers on social media.

BENEFIT

Working with influencers helps you to create unique, engaging content that builds brand awareness, improving the ROI of marketing campaigns.

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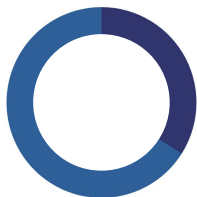
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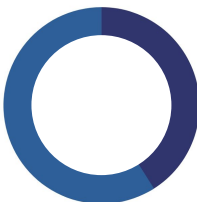
People Operations

Employee Training & Upskilling



34%

employees are very satisfied with their job-specific training



41%

of them consider it to be very important

CHALLENGE

Many employees get stuck in a rut and don't know which skills to develop to grow their careers. Guiding employees to the skills they need to take their careers to the next level is critical for employee happiness and retention.

WHY GRAPH DATA SCIENCE

A recommendation engine based on a knowledge graph offers insight into the skills employees have today and the skills they can build on for the future. Using community detection, similarity, and centrality, companies can help employees answer the question, "What training is most appropriate for me to take next?"

BENEFIT

Companies that grow their talent see less turnover and happier employees.

SUPPORTING GRAPH ALGORITHMS

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[Community Detection](#)

[Similarity](#)

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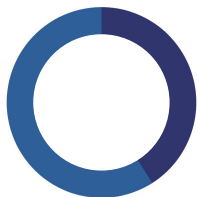
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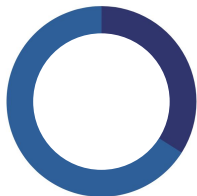
Scale to hundreds of billions of nodes and relationships

Internal Backfill Optimization



47%

Overtime is used to cover 47% of employee absences



29.5%

co-workers are perceived to be 29.5% less productive when covering for absent employees.

CHALLENGE

Many industries rely on employees with highly specialized skills and certifications. In manufacturing, construction, healthcare, and others, operations can slow or even stop when an employee is suddenly unavailable.

WHY GRAPH DATA SCIENCE

With employee skills categorized within a graph database, you can run a similarity algorithm to find the best replacement for people who are sick or on leave. For key roles and skills, this analysis can be done proactively to strengthen organizational resiliency.

BENEFIT

Creating a graph of employee skills, certifications, and abilities empowers companies to quickly identify people who can fill in to keep operations humming and customers happy.

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Operations

Cybersecurity: Data Loss Prevention

By stealing 10 credit cards per website, cybercriminals earn up to
\$2.2 million
through formjacking attacks.

CHALLENGE

Cyber threats are multiplying. Organizations deploy dozens of security tools, each of which generates alerts and logs for security analysts to sift through and correlate.

WHY GRAPH DATA SCIENCE

Your network is a graph, so modeling it in a graph is natural and powerful. Data scientists run graph algorithms, specifically similarity analysis and community detection algorithms, to surface anomalies that may indicate threat activity.

BENEFIT

Graph data science empowers security teams to find anomalies across all of their data and prioritize their efforts to help shield their organizations from data breaches and intellectual property theft.

SUPPORTING GRAPH ALGORITHMS

[Community Detection](#)

[Similarity](#)

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[Graph Embeddings](#)

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Data Unification

*Organizations
believe poor data
quality to be
responsible for an
average of
\$15 million
per year in losses.*

CHALLENGE

Businesses need solid, reliable data about customers to make good decisions about offers, renewals, and other touchpoints, but many entries in customer relationship management systems are duplicates, incomplete, or contain inaccurate information.

WHY GRAPH DATA SCIENCE

Graph data science works for unifying multiple records because it finds connections that are otherwise hidden. Community detection and similarity graph algorithms can be used to disentangle and consolidate incomplete, duplicative data scattered across systems to create a single, unified record.

BENEFIT

Solid, reliable data about customers helps businesses be more effective in communications across marketing, sales, and services.

SUPPORTING GRAPH ALGORITHMS

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Network Monitoring

CHALLENGE

To ensure network resource availability and uptime across the organization, IT managers need a way to detect anomalies in equipment quickly and accurately.

WHY GRAPH DATA SCIENCE

Networks are natural graphs. Using centrality, community detection, and pathfinding algorithms, data scientists analyze network traffic data to detect unusual events requiring attention – whether for troubleshooting, impact analysis, or outage planning.

BENEFIT

Companies that can identify and predict problems before they occur can avoid network outages, resulting in organizational resilience and cost savings.

*The average cost
of downtime is*

\$1,467

per minute.

SUPPORTING GRAPH ALGORITHMS

Centrality

Community Detection Pathfinding

Graph Embeddings

Link Prediction

Similarity

Supervised ML

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Supply Chain

Route Optimization



25%

The transportation industry is responsible for over 25% of all greenhouse gas emissions.

CHALLENGE

Optimized routes can save field service organizations, supply chain managers, transportation teams, and others money and time. But, with numerous variables that change in real time, getting it right remains an obstacle.

WHY GRAPH DATA SCIENCE

Supply chains naturally form graphs with multiple interconnecting stages consisting of suppliers, customers, distribution hubs, and other elements. Use pathfinding algorithms to identify the shortest and most efficient routes through these stages in your supply chain.

BENEFIT

Being able to respond to market shifts in real time empowers companies to optimize route planning, shorten delivery times, increase customer satisfaction, and cut costs, as well as reduce carbon emissions.

SUPPORTING GRAPH ALGORITHMS

[Pathfinding](#)

[Centrality](#)

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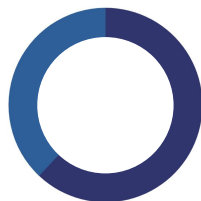
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Risk Identification



62%

Supply chain disruptions can cause a massive 62% loss in finances.

CHALLENGE

Supply chain disruption affects all aspects of business, causing delays, unexpected costs, and an inability to meet customer expectations.

WHY GRAPH DATA SCIENCE

Supply chains consist of complex, interlinked systems that naturally form a graph. Graph algorithms like betweenness centrality and pathfinding help identify critical flows, routes, and dependencies.

BENEFIT

Graph analytics allow you to better assess, manage, and mitigate potential risks such as delays, shortages, and other failures.

SUPPORTING GRAPH ALGORITHMS

[Betweenness Centrality](#)

[Pathfinding](#)

Centrality

Graph Embeddings

Pathfinding

Link Prediction

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Inventory Management



63%

On average, U.S. retail operations have inventory accuracy of only 63%.

CHALLENGE

Inventory management is a constant battle because inventory levels fluctuate and product demand keeps changing, making it hard to predict how much of a product to make or keep on hand.

WHY GRAPH DATA SCIENCE

Companies use graph data science to create a global view of inventory data so they can redeploy existing inventory and search for similar products in the event of a shortage. Centrality and similarity algorithms make it feasible to identify key suppliers, empowering companies to act strategically and negotiate better prices.

BENEFIT

Analyzing inventory within a graph builds agility and resilience, allowing companies to reduce risk in times of shortage, cut purchasing costs, and diversify their supply chain as necessary.

SUPPORTING GRAPH ALGORITHMS

[Centrality](#)

[Similarity](#)

[Pathfinding](#)

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Customer Service

Next Best Action

First interaction problem resolution is most valued

#1

in a customer service interaction.

CHALLENGE

It's not always possible to solve a problem for a customer in one shot, but scrambling for the next best action – or being unable to find a solution at all – reduces customer satisfaction and slows down resolution time.

WHY GRAPH DATA SCIENCE

A graph captures all the possible scenarios for the next step, along with what worked for previous customers. To help service agents provide the next best action for a problem, data scientists can build a recommendation system using similarity algorithms, pathfinding algorithms, and node embeddings.

BENEFIT

Generating recommendations based on data from past behaviors enables faster resolution times. Satisfied customers are more likely to upgrade or add services and less likely to cancel, which increases revenue and market expansion.

SUPPORTING GRAPH ALGORITHMS

[Node Embeddings](#)

[Pathfinding](#)

[Similarity](#)

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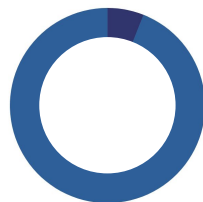
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Optimize Knowledge Base



6%

Providing customers with short tutorials on product features before hanging up can reduce churn by 6%.

CHALLENGE

Efficiently aiding customers can be a challenge when sorting through a barrage of articles to find the one most relevant to the issue. This slows down service times.

WHY GRAPH DATA SCIENCE

Companies use Neo4j Graph Data Science to recommend the articles most likely to solve customer problems. Similarity algorithms and centrality algorithms use graph structure to find the most relevant information the first time.

BENEFIT

Quickly aiding a customer and providing them with the best answer to an inquiry or solution to a problem reduces resolution times, increasing customer satisfaction.

SUPPORTING GRAPH ALGORITHMS

[Centrality](#)

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Financial Services



Fraud Detection

Financial Services are facing three key types of fraud:

- 1. Customer Fraud;*
- 2. Cybercrime; and*
- 3. Know Your Customer Failures*

CHALLENGE

Hackers and organized crime rings are on the rise while transaction platforms are growing in complexity – making it harder, but more important than ever, to identify fraudulent transactions and potential fraudsters.

WHY GRAPH DATA SCIENCE

Graph-based approaches to fraud detection explicitly model relationships between entities in the data. This, coupled with Neo4j Graph Data Science, empower practitioners to rapidly explore, analyze, resolve, and predict entities and patterns that most likely indicate fraud. These patterns can remain obfuscated using conventional data science techniques without a graph.

BENEFIT

Detecting fraud as soon as possible enables faster shutdown and prevention, reducing illicit activity and facilitating a better, safer, and more secure customer experience.

SUPPORTING GRAPH ALGORITHMS

[Community Detection](#)

[Similarity](#)

[Pathfinding](#)

[Graph Embeddings](#)

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Government



Fraud Detection & Criminal Investigations

*Government & Public
Sector - Top Types of
Fraud Experienced:*



36%

Cybercrime



28%

Customer
Fraud



33%

Asset Misappropriation

CHALLENGE

From taxes to healthcare claims, loan programs, and other benefits, fraud against the government impacts everyone. A single instance of public assistance fraud can cost millions.

WHY GRAPH DATA SCIENCE

Modeling large, often disparate data sources as a graph enables algorithms like community detection to help detect bad actors and fraud rings. Further, algorithms like centrality and similarity, and graph feature engineering like node embedding can be used to advance prediction and machine learning techniques to flag suspicious activity.

BENEFIT

Fraud and crime hidden in oceans of data are found, facilitating faster shutdown of criminal activities and prosecution of criminals.

SUPPORTING GRAPH ALGORITHMS

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Life Sciences

Drug Discovery

*It typically takes
3-5 years to discover
and refine the drug
intended development.*

CHALLENGE

Finding new drug candidates entails interrogating vast amounts of data and typically takes years.

WHY GRAPH DATA SCIENCE

Graph technology enables drug companies to create a system of scalable biological knowledge that consolidates disparate datasets. By using techniques like link prediction, data scientists discover the connections between diseases and biomolecules – which inform the development of new drugs.

BENEFIT

New and effective drugs are brought to market faster, with potentially life-saving results.

SUPPORTING GRAPH ALGORITHMS

[Centrality](#)

[Community Detection](#)

[Link Prediction](#)

[Node Classification](#)

[Node Embeddings](#)

[Similarity](#)

[Pathfinding](#)

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Retail

Increase Order Size

*Shopper spend soars with personalization. Purchases where a recommendation was clicked saw a **10%** higher average order value, and the per-visit spend of a shopper who clicks a recommendation is five times higher.*

CHALLENGE

Retailers always want to sell customers as much as possible, but recommending products that are most likely to catch a buyer's attention before they check out can be hard.

WHY GRAPH DATA SCIENCE

Recommendation engines powered by Neo4j Graph Data Science drive the most personalized experience for shoppers. Similarity and centrality algorithms find products the user will like based on their history along with items purchased by similar users.

BENEFIT

Quality recommendations increase spend and create experiences that delight customers. Delighted customers are likely to shop with you again and consider your recommendations.

SUPPORTING GRAPH ALGORITHMS

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Apply Neo4j Graph Data Science To Improve Predictions

Neo4j Graph Data Science Advantages

- The only graph data science engine built to improve predictions and ML models
- Operates at enterprise scale
- Provides seamless integration across the data stack to get more data science projects to production

Neo4j Graph Data Science is a data analytics and ML engine that helps you understand the connections in big data to answer critical questions and improve predictions. It uses these data relationships to discover fast, actionable insights and plugs into enterprise data ecosystems so you can get more data science projects into production quickly.

With a ready-to-use library of over 65 pretuned graph algorithms, data scientists can explore billions of data points in seconds to identify hidden connections and generate compelling visualizations that contribute to more informed decision making.

Ready to learn how graph data science can help your organization?

Questions?

[Contact a graph data science specialist](#)

Do a Test Run in Our

[Graph Data Science Sandbox](#)

Endnotes

Finance

Fraud Detection: PwC, [Global Economic Crime and Fraud Survey 2022](#)

Resource Allocation: HighRadius, [CFO Survey Results: Priorities and Action Plans 2022](#)

Churn Prediction: Esteban Kolsky, [Customer Experience For Executives](#)

Marketing

Funnel Optimization: McKinsey & Company, [Why every business needs a full-funnel marketing strategy](#)

Customer 360: Tadhg Nagle, Tom Redman, David Sammon, [Assessing Data Quality: A Managerial Call to Action](#)

Market Segmentation: Mailchimp, [Effects of List Segmentation on Email Marketing Stats](#)

Influencer Identification: Influencer Marketing Hub, [The State of Influencer Marketing 2021: Benchmark Report](#)

People Operations

Employee Training & Upskilling: Lorman, [39 Statistics that Prove the Value of Employee Training](#)

Internal Backfill Optimization: Society for Human Resource Management, [Total Financial Impact of Employee](#)

[Absences Across the United States, China, Australia, Europe, India and Mexico](#)

Endnotes

Operations

Cybersecurity: Data Loss Prevention: Symantec, [Internet Security Threat Report](#)

Data Unification: Gartner, Inc., [How to Create a Business Case for Data Quality Improvement](#)

Network Monitoring: Symantec, [Internet Security Threat Report](#)

Supply Chain

Route Optimization: EPA, [Fast Facts on Transportation Greenhouse Gas Emissions](#)

Risk Identification: Zippia, [17 Stunning Supply Chain Statistics \[2022\]: Facts, Figures, And Trends](#)

Inventory Management: Zippia, [17 Stunning Supply Chain Statistics \[2022\]: Facts, Figures, And Trends](#)

Customer Service

Next Best Action: Genesys, [State of Customer Research](#)

Optimize Knowledge Base: Harvard Business Review, [Stop Trying to Delight Your Customers](#)

Industries

Financial Services: Fraud Detection, PwC, [Global Economic Crime and Fraud Survey 2022](#)

Government: Fraud Detection, PwC, [Global Economic Crime and Fraud Survey 2022](#)

Life Sciences: Drug Discovery, Eureka, [Why Does Drug Development Take So Long?](#)

Retail: Increase Order Size, Salesforce, [Personalization in Shopping](#)