Enhancing Insurance Fraud Detection through Graph-Based Link Analysis

The Challenge

Technology is increasingly used as both a force for good and as a means to exploit vulnerabilities that greatly damage organizations – whether financially, reputationally, or through the release of classified information. Consequently, efforts to combat this fraud must evolve to become more sophisticated with each passing day. The field of fraud analytics is rapidly emerging and, over the past 10 years, has expanded to include graph analytics as a critical method for detecting suspicious behavior.

In one such application, a national agency overseeing insurance claims engaged EK to advise on developing and implementing graph-based analytics to support fraud detection. The agency had a capable team of data scientists, program analysts, and engineers focused on identifying suspicious activity among insurance claims, such as:

- Personal information being reused across multiple claims;
- Claims being filed under the identities of deceased individuals; or
- Individuals claiming insurance from multiple locations.

However, they were reliant on relational databases to accomplish these tasks. This made it difficult for program analysts to identify subtle connections between records in tabular format, with data points often differing by just a single digit or character. Additionally, while the organization was effective at flagging anomalies and detecting potentially suspicious behavior, they faced challenges relating to legacy software applications and limited traditional data analytics processes.

EK was engaged to provide the agency with guidance on standing up graph capabilities. This graph-based solution would transform claim information into interconnected nodes, revealing hidden relationships and patterns among potentially fraudulent claims. In addition, EK was asked to build the agency's internal expertise in graph analytics by sharing the methods and processes required to uncover deeper, previously undetectable patterns of suspicious behavior.

The Solution

To design a solution suitable for the agency's production environment, EK began by assessing the client's existing data infrastructure and analytical capabilities. Their initial cloud solution featured a relational database, which EK suggested extending with a graph database through the same cloud computing platform vendor for easy integration. Additionally, to identify suspicious connections between claims in a visual format, EK recommended an approach for the agency to select and integrate a link analysis visualization tool.

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These tools are crucial to a link analysis solution and allow for the graphical visualization of entities alongside behavior detection features that identify data anomalies, such as timeline views of relationship formation. EK made this recommendation using a custom and proprietary tooling evaluation matrix that facilitates informed decision-making based on a client's priority factors. Once the requisite link analysis components were identified, EK delivered a solution architecture with advanced graph machine learning functionality and intuitive user experience that promoted widespread adoption among technical and nontechnical stakeholders alike.

EK also assessed the agency's baseline understanding of graphical link analysis and developed a plan for upskilling existing data scientists and program analysts on the foundations of link analysis. Through a series of primer sessions, EK's subject matter experts introduced key concepts such as knowledge graphs, graph-based link analysis for detecting potentially suspicious behavior, and the underlying technology architecture required to instantiate a fully functional solution at the agency.

Finally, EK applied our link analysis experience to address client challenges by laying out a roadmap and implementation plan that detailed challenges along with proposed solutions to overcome them. This took the form of 24 separate recommendations and the delivery of bespoke materials meant to serve as quick-start guides for client reference.

The EK Difference

During the course of the engagement, EK relied on its deep expertise in unique domains such as knowledge graph design, cloud-based SaaS architecture, graph analytics, and graph machine learning to propose an easily implementable solution. To support this goal, EK developed an architecture recommendation that prompted as few modifications to existing programs and processes as possible. With the proposed novel architecture utilizing the same cloud platform that already hosted client data, the agency could implement the solution in production with minimal effort.

Furthermore, EK adapted a link analysis maturity benchmark and tool evaluation matrix to meet the agency's needs and ensure that all solutions were aligned with the agency's goal. Recognizing that no two clients face identical challenges, EK delivered a customized suite of recommendations and supporting materials that directly addressed the agency's priorities, constraints, and long-term needs for scale.

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The Results

Through this engagement, EK provided the agency with the expertise and tools necessary to begin constructing a production-ready solution that will:

- Instantiate claims information into a knowledge graph;
- Allow users to graphically explore suspicious links and claims through intuitive, no-code visualizations;
- Alert partner agencies and fraud professionals to suspicious activity using graph-based machine learning algorithms; and
- Track changes in data over time by viewing claims through a temporal lens.

In parallel, key agency stakeholders gained practical skills related to knowledge graphs, link analysis, and suspicious behavior detection using graph algorithms and machine learning, significantly enhancing their ability to address complex insurance fraud cases and support partner agency enforcement efforts.

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