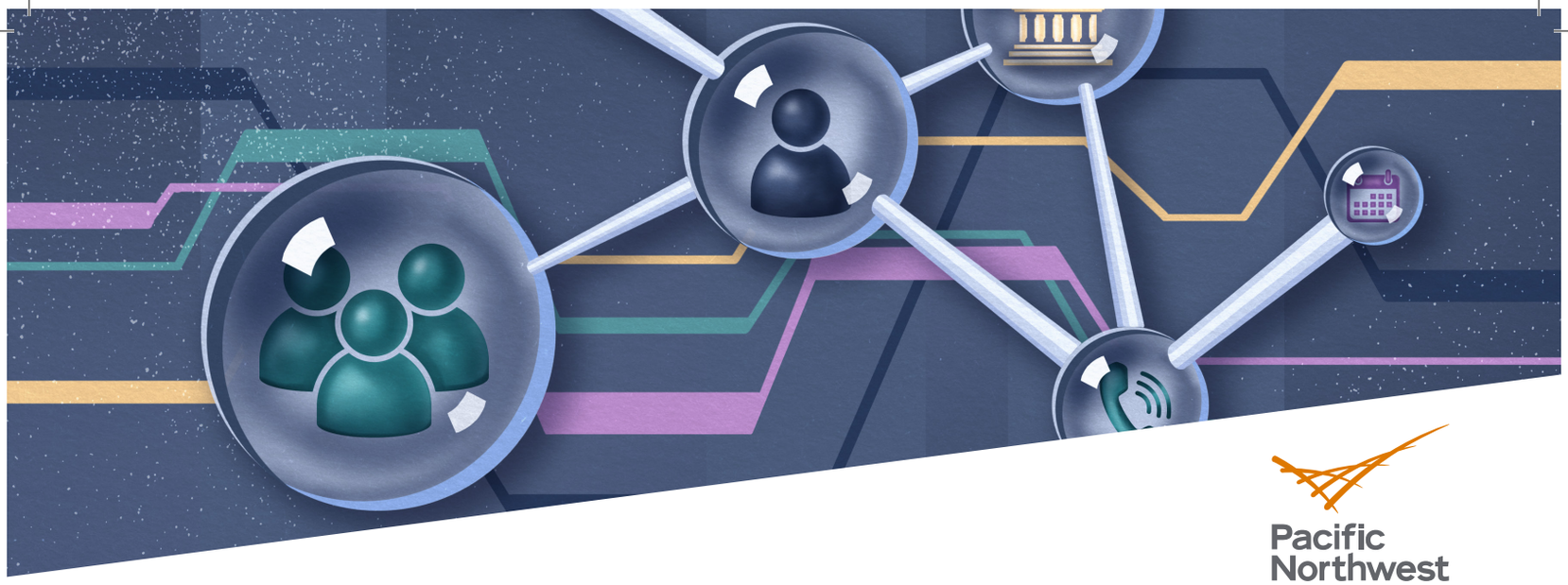


Pacific Northwest
NATIONAL LABORATORY

Graph Analytics

Revealing insights through graphic network structures

THE CHALLENGE

Analysts need to understand patterns in complex systems, such as social, biological, cyber, energy, sensor, and business networks. Graph analytics uses graph structures to model and understand the strength and direction of relationships between entities in these networks. Analyzing these relationships reveals insights and anomalies, such as emerging technologies, trends, or threats. This is useful in fields such as international trade, counter-proliferation, and cyber-physical protection.

APPROACH

Pacific Northwest National Laboratory (PNNL) is pioneering graph analytics and network science to analyze complex relationships through visualization and machine learning. We deliver novel algorithms for anomaly and event detection, node centrality, community detection, influence maximization, and pattern matching. These algorithms produce graphics that translate raw data to insights, telling a story from which non-specialists can gain insights.

Our visualization and analytic approaches have enabled analysts to solve previously intractable problems. For example, many commercially available graph analytics tools are limited to around 200,000 points (nodes) in a graph. In contrast, PNNL tools such as Green Hornet enable organizations to explore data sets with more than one million vertices, using a unique multiscale approach. We also apply these techniques to custom, domain-specific applications, such as the award-winning Streamworks tool, which detects potential cyberattacks, in real time, as data flows between computers, users, and applications.

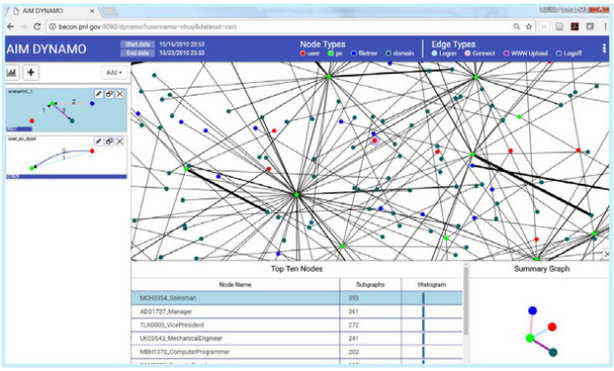
Our graph analytics technologies have been deployed for threat detection, cyber analytics, scientific computing, intellectual property portfolio analysis, energy grid reliability, environmental safety, training, and law enforcement.

EXAMPLE PROJECTS

Storyline Visualization with SVEN

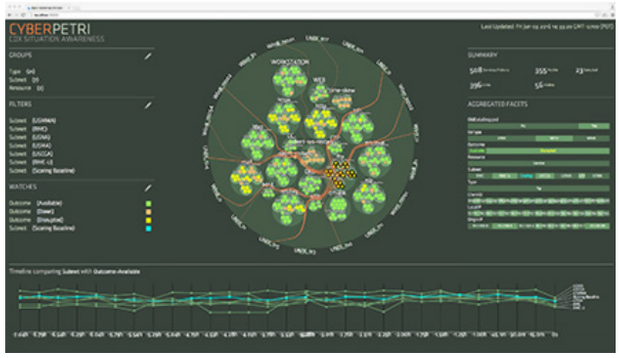
Storyline visualization is a compelling way to communicate fine-grained patterns of change over time. Entities appear as converging and diverging lines, with time encoded on the horizontal axis. PNNL's SVEN tool combines multiple graph optimization algorithms to reduce clutter and improve visualizations. It computes storyline layouts in a web browser in milliseconds, generating designs that have proven less misleading for novice users than current techniques.

DYNAMO



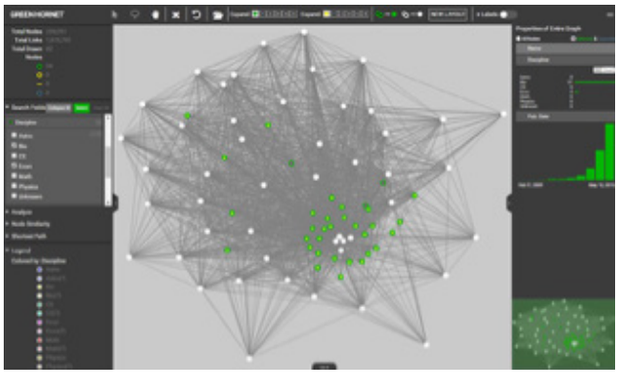
Analysts need to know not only when things happen, but also in what order they occurred. DYNAMO is being developed to find patterns of interaction in data streams over space and time. DYNAMO has been applied to detecting cyberattacks in computer networks, insider-agent activity in multi-source data streams, and material growth and interactions in electron microscopy images.

Ocelot



Ocelot is a network defense tool that helps security analysts understand and respond to active defense scenarios. The novel visualization technique provides a flexible network map based on characteristics such as Internet protocol addresses, operating systems, or services.

Green Hornet



Green Hornet is a user-friendly software tool supporting large graph exploration and visualization for social network analysis, cybersecurity, infrastructure security, and more. Analysts can interactively explore graphs with millions of nodes via its unique multi-scale approach, which clusters closely connected nodes into a much smaller set of supernodes. Individual nodes can then be drilled down and extracted, based on their metadata attributes or graph properties. This allows an analyst to see individual nodes and links of interest, while retaining their context within the larger graph.

About PNNL

PNNL advances the frontiers of knowledge, taking on some of the world's greatest science and technology challenges. Distinctive strengths in chemistry, earth sciences, and data analytics are the heart of our science mission, laying a foundation for innovations that improve America's energy resiliency and enhance our national security. PNNL's computing research encompasses data and computational engineering, high-performance computing, applied mathematics, and semantic and human language technologies.

Collaborate with us | Tap into our capabilities to meet your needs | Explore technology transfer opportunities | Join our team to grow your career

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