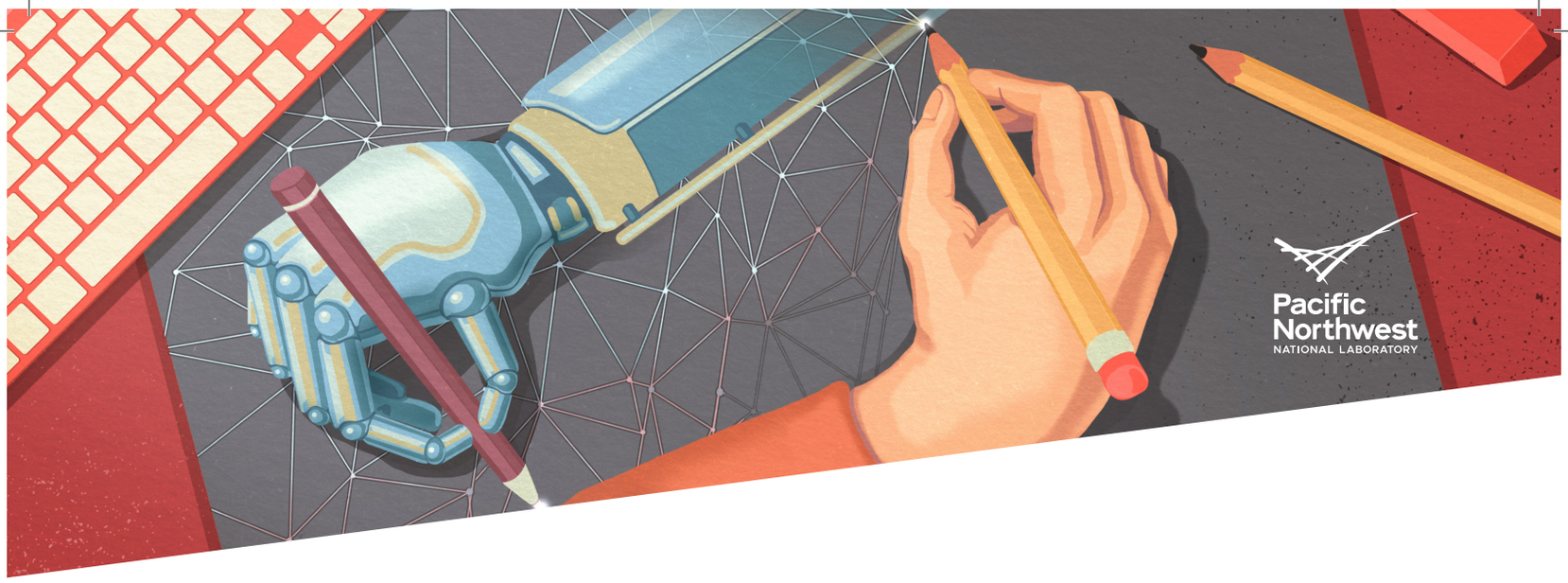


Human-Machine Teaming

Combining computer analytics with human creativity and intuition

THE CHALLENGE

Much of today's human-machine interaction places a heavy burden on the human. The user is often either directing the tool to perform specific tasks or closely monitoring it to ensure accurate performance. We recognize a new opportunity to build machines that can work with the user to meet their goals, rather than blindly executing tasks. These new machines can both enhance team performance and minimize the work required for the human to manage the machine. To accomplish this vision requires developing technology that functions less like a tool and more like a teammate. Teammates have enough autonomy to get the job done, but also stay connected with their team. They learn from their teammate while providing suggestions, support, and back up when their teammate needs help.

APPROACH

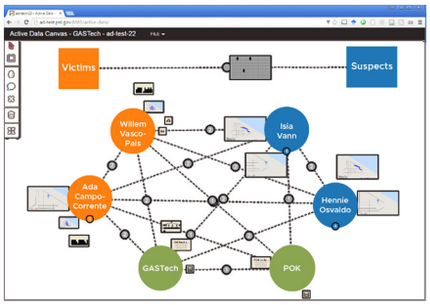
Pacific Northwest National Laboratory (PNNL) is leading the development of a new generation of smarter machines that will support the human as a teammate. These machines can capture knowledge from interacting with expert users and can learn and adapt to the human teammate's work patterns. Their ability to learn gives these tools the power to help the human prioritize what is important and recommend the right analytics for analysts at the right time. These machines can also provide explanations for their behavior, when needed, to help foster trust.

PNNL is exploring how human-machine teaming can be applied to complicated problems of national importance, such as making emergency response decisions and thwarting first-of-a-kind cyber-attacks. Solving these problems requires advanced computation of multi-source data and must account for ambiguity and answers that vary, depending on evolving conditions.

As a multidisciplinary national laboratory, we bring key capabilities to this research. We apply expertise in interactive visual analysis, automated analytics, and topic-based recommender systems. We conduct human factors research and cognitive systems engineering to understand which characteristics a machine needs to become a valued teammate. Our controlled human-machine interaction research is conducted in our Human Performance Assessment and Modeling Laboratory.

EXAMPLE PROJECTS

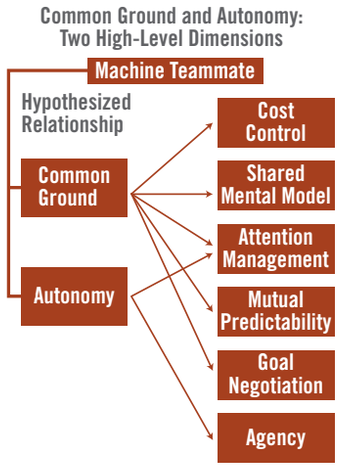
Active Data



When analysts interpret dynamic data from multiple sources, it's crucial not to miss something important. Active Data infers the human analysts' interests and recommends potentially relevant data and analytic results—even from sources that may not be obvious to the human. PNNL is collaborating with SRI International and government partners to develop this software.

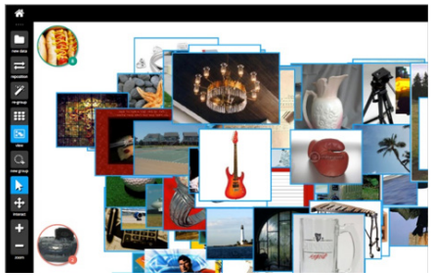
Teammate

Teammate is a research and design effort to build a machine analytic assistant (MAA) that functions more like a teammate than a tool. The MAA will be designed to establish and maintain common ground with the analyst by relying heavily on a visual language as the team works to solve complex problems. This iterative design process is informed by PNNL's Heuristics for Machine Teammate Design and human subjects research.

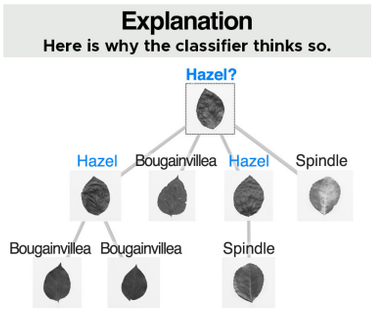


Sharkzor

Sharkzor uses human-in-the-loop machine learning to sort and summarize images. As the human interacts with the images, deep learning algorithms infer, augment, and automate the person's mental model. This loop of interaction, automation, and response helps a human make sense of large amounts of data quickly.



Escape Routes



Escape Routes displays simplified visuals that explain how the machine selected certain images for classification groups and rejected others. Users can see and correct flaws in the computerized decision making. In tests, Escape Routes improved the human-machine team's accuracy more than with either the human or machine alone.

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.

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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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