Understanding sequential behavior is crucial to many defense-related tasks. Why did a drone make a sudden movement away from its destination? Why did a rover choose a certain path? Does a patrolling soldier’s route indicate the presence of danger? Two SEI projects offer novel solutions toward modeling and explaining sequential behavior.

Identifying Unlikely Events
Current methods for identifying unlikely or anomalous events require labeled data about what constitutes an unlikely event and the time of human operators to verify predictions. We are using inverse reinforcement learning, an approach based in machine learning, which learns a statistical model of routine and anomalous actions that are taken from each state.

Modeling Ship Paths
Using publicly available Automatic Identification System (AIS) data collected by the U.S. Coast Guard, we use inverse reinforcement learning to model trajectories of marine vessels into New York Harbor. We can use these models to predict where vessels are going, find anomalous behavior, and potentially classify vessel type based on trajectory.

Future Work
In a collaboration with the Carnegie Mellon University Parallel Data Laboratory, we will use inverse reinforcement learning to model behavior of supercomputer users. This collaboration extends our work beyond predicting movements in the physical world and into domains such as cybersecurity, social networks, and more.

Prior Work: Explaining Robot Behavior
For human soldiers working with robot counterparts, being able to predict robot behavior ensures trust and supports human-machine teaming. Our “What Will the Robot Do Next” project has developed algorithms for robots to proactively adapt their behavior to enable users to predict what the robot will do next.