

Predicting Operator Needs Through Machine Learning and Intelligent Tutoring

About Siemens Healthineers

Siemens Healthineers develops innovations that support better patient outcomes with greater efficiencies, giving healthcare providers the confidence they need to meet the clinical, operational and financial challenges of a changing healthcare landscape. As a global leader in medical imaging, laboratory diagnostics, and healthcare information technology, we have a keen understanding of the entire patient care continuum—from prevention and early detection to diagnosis and treatment.

Laboratory Diagnostics and Operator Help

Approximately 70% of clinical decisions are driven by in vitro lab results. Siemens Healthineers Laboratory Diagnostics is committed to helping labs transform their technology and workflow solutions to support early and precise diagnosis and patient care. This mission requires continuous improvement in streamlining operations with customized and intuitive workflows, offering a robust and wide-ranging assay menu, providing performance-based service offerings, and digitalizing processes and workflows.

The Atellica® Solution offers flexible, scalable, automation-ready configurations of immunoassay and chemistry analyzers to drive better patient outcomes. Although some maintenance and troubleshooting tasks are automated, the complexity of the system and the number of possible configurations requires that operators have access to the appropriate help information at the time they need help without extensive searching. Understanding system events, operator patterns of usage, and available help content could lead to development of an intelligent tutor that provides suggested troubleshooting or help information to operators when they need it.

Project Overview

The Atellica Solution logs various data about system events and operator usage. The System Log records information about the actions the system performs and all events (errors and warnings) that occur on the system, some of which are displayed to operators. The Operator Event Log records information about all system events that are displayed to operators. The Online Help Log records the online help content that operators accessed. Looking at these three logs in parallel could reveal system behaviors and features that prompt operators to seek help, enabling the system to predict when operators may need help and what content is appropriate.

Project Scope

The goal of this project is to understand how data that are already logged by Atellica Solution may be used to train a machine algorithm to anticipate and provide troubleshooting and other help to operators at the time they need it.

Phase I – Research Framework

Data Analysis of Atellica Solution Logs

Atellica Solution uses Smart Remote Services (SRS) to transmit its log files to Siemens Healthineers. A Data Analytics group then makes the logs available for download and analysis. For the first phase of the research, we are asking you to conduct statistical analyses for the data in the three logs (System, Operator Event, and OLH) to reveal patterns in the data regarding system behavior and operator needs. From this, we would like you to deliver a report of the findings and an application to convert a subset of the logs into a format suitable for input to a machine learning algorithm.

Predicting Operator Assistance Needs with Machine Learning

After extracting and filtering the structured datasets from the three logs, the next step is to develop a research framework for using the log data to train a machine learning algorithm and demonstrate that the algorithm can accurately predict the help content that operators may need when certain system behavior occurs.

This research framework should indicate potential machine learning techniques that could be implemented using the log data, such as Decision Trees (CART), Support Vector Machines (SVM), Artificial Neural Networks (ANN), or other method. You will use the technique you choose in Phase II to build a prototype machine learning algorithm that predicts the help content operators may need when experiencing certain system events.

The framework should also include a method to display summary information about the patterns the machine learning algorithm finds with system behavior and the actions taken based on those patterns. The actions should include what operator help content was displayed.

Phase II – Rapid Prototyping

After devising the research framework, the next step is to implement the selected machine learning technique with the Atellica Solution data. The outcome should be a model demonstrating that the machine learned about system and operator behavior and recommended (displayed) appropriate help topics to operators at the time they required it to act in response to system events.

Because of the ambitious scope of the project, Siemens is committed to working closely with you to ensure that this project is solvable and successful.

NOTE: Students will be required to sign Non-Disclosure Agreements and sign over Intellectual Property (IP) to Siemens Healthineers when the team is formed.

Cornell Faculty Lead/Contact:

Dr. Fengqi You
Roxanne E. and Michael J. Zak Professor
fengqi.you@cornell.edu | www.peese.org