

AUTOMATE ZERO-DAY ANOMALY DETECTION AND ROOT CAUSE ANALYSIS ON LARGE DATASETS

ATTENDS: Advanced Multi-Variate Time Series Analytic Techniques

ATTENDS: ADVANCED MULTI-VARIATE TIME SERIES ANALYTIC TECHNIQUES

As civil and military platforms increase in capability, the number of diverse and interconnected sensors within them, also increases. During testing and evaluation, as well as on-going operations and maintenance, thousands of sensors generate huge quantities of time-series data. While these data contain valuable insights and could provide visibility into platform behavior and failure mechanisms, their use is often severely limited. For practical reasons, analyses are typically limited to reviewing very small subsets of the data and alerts for pre-determined conditions and known risk conditions.

With the ever-increasing complexity of missions and platforms and the advent of multi-domain operations (MDO), these analytic limitations are a significant and growing concern. Without the ability to identify zero-day anomalies, uncover unanticipated conditions, and pinpoint root causes, critical platforms are subject to unknown vulnerabilities.

ATTENDS is designed to meet this challenge. ATTENDS enables and automates knowledge discovery and causal analysis on massive, heterogeneous datasets via novel applications of artificial intelligence (AI) and machine learning (ML) algorithms.

The ATTENDS system provides:

- Fast, automated data ingestion and fusion with a flexible data architecture that supports structured, semi-structured, and unstructured datasets
- Knowledge management architecture with AI-aware knowledge model to extract information from meta data with minimal human involvement
- Flexible workflow engine with batch and query modes to orchestrate data processing flows
- Innovative multi-variate time series analytic methods to capture temporal dynamics in sensor data
- Automatic configuration, training, and application for a wide range of ML algorithms and training techniques
- Synthetic data generation to augment training data
- Unsupervised learning for zero-day anomaly detection and knowledge extraction
- APIs (application programming interface) to support user configurability and remote invocation
- Easy-to-use interface to support of test, evaluation, and maintenance operations

KEY FEATURES OF ATTENDS

Allows data mining on large, previously inaccessible datasets with diverse formats. ATTENDS' fast data ingestion makes multi-modal, multi-variate time series data – such as that collected from flight recorders during execution of test and evaluation missions – fully available for exploratory analysis.

Automates relevance analysis of metadata and extraction of salient information. Metadata, or data about the data, includes information such as the age, location, and type of embedded sensors and sensor interconnections; it is crucial to effective analysis. ATTENDS uses an AI-knowledge model and architecture to automate analysis and extraction of information from metadata, at substantial savings in effort and time.

Identifies hidden correlations, unanticipated trends, and zero-day anomalies. ATTENDS deploys unsupervised ML to extract unexpected patterns and zero-day anomalies. With built-in and easy-to-use unsupervised learning, ATTENDS discovers “unknown unknowns” and previously hidden faults.

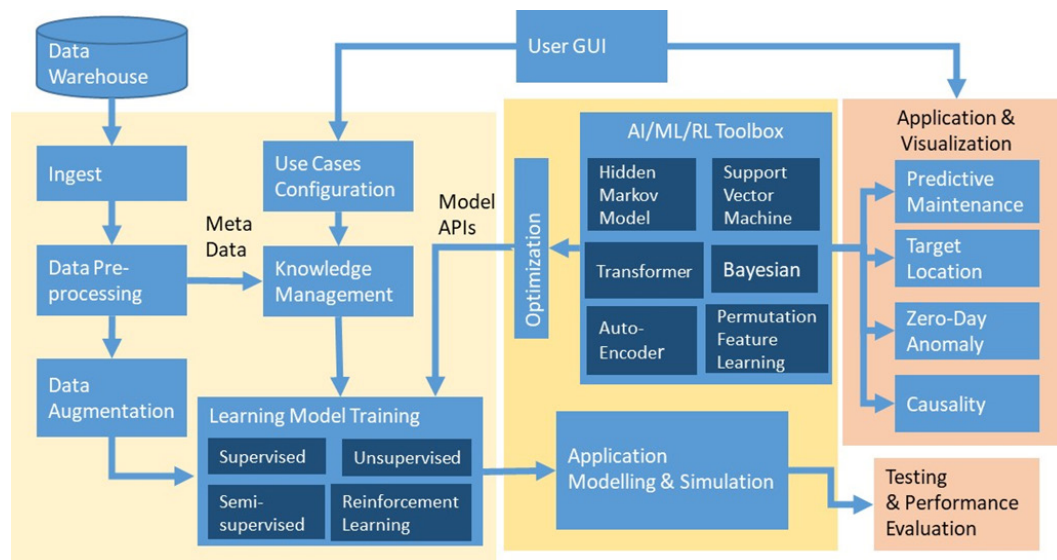
Supports predictive maintenance and root cause failure analysis. Embedded sensors monitor systems to detect and address glitches before they become significant problems. ATTENDS has powerful analytic techniques and ML algorithms that harness multi-modal sensor data to rapidly detect anomalies, correlate alerts, predict failure states, diagnosis problems, and identify root causes.

Delivers deep dive diagnosis capability. ATTENDS query mode, together with its graphical user interface (GUI), provide users with guided input and helpful visualization to support deep dive diagnosis of potential vulnerabilities and risks.

Extends easily to other massive datasets with varying formats. ATTENDS is a general-purpose, automated system for knowledge discovery and data analysis. It provides speedy operational support and lightens analyst workloads across diverse applications – from failure analysis, estimates of equipment remaining useful life (RUL), and detecting errors in target location – to improving testing and evaluation of AI/ML algorithms and extracting information across diverse sensors on land, sea, air, space, and cyber for MDO.

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ATTENDS SYSTEMS ARCHITECTURE

ATTENDS uses a streamlined workflow engine to orchestrate data processing for flow-through analytics and to coordinate across data ingestion, storage, training, analysis, execution of AI/ML algorithms, and presentation of results to the user. The workflow manager schedules data ingestion from external sources, necessary pre-processing of data, and training of AI/ML models. It also automates the generation of analytic results using the trained AI/ML models. Analysts interact with models and results via APIs and the GUI, which has extensive data visualization capabilities to aid user understanding.

The knowledge management module is implemented via directed graphs and contains domain knowledge about the AI/ML algorithms, datasets, and metadata. Salient knowledge is automatically extracted from the metadata via sophisticated unsupervised learning algorithms. The workflow manager will, as needed, retrieve information from the knowledge store about a dataset to determine how it should be preprocessed to support the training of AI/ML models, including the use of data augmentation if needed.

The ATTENDS architecture is designed not only to support a wide variety of AI/ML tools and algorithms, but also to easily incorporate new AI/ML algorithms with minimal, incremental effort. This is achieved through the AI/ML APIs that support user configurability and remote invocation, and the inclusion of multiple ML learning methods (supervised, semi-supervised, unsupervised, and reinforcement learning).

ATTENDS has applications for predictive maintenance, including failure detection and RUL, as well as target location error analysis, zero-day anomaly detection, identification of causality, and root cause analysis. Other analytics applications can be easily added for use cases involving very large datasets and multi-modal sensor data.

ATTENDS VALUE AND BENEFITS

- Enables data mining and knowledge extraction from complex, voluminous datasets, which had been largely inaccessible due to their massive size
- Meets mission needs for operational timeliness via fast ingestion and automation expedited anomaly detection
- Provides time saving orchestration across the data processing and analysis workflow
- Lightens operator's workload via sophisticated techniques in time series analytics and AI/ML algorithms and tools
- Harnesses unsupervised learning to discover "unknown unknowns" and valuable insights that were hidden
- Deep dive capabilities and causal analysis provide guided problem diagnosis – diagnosis is historically among the hardest problems, requiring very experienced personnel who are scarce and in high demand
- Provides automated data augmentation as needed for training ML models
- Proven effectiveness in zero-day anomaly detection, root cause analysis, and target location error detection and analysis
- Flexible and extensible platform that easily adds new AI/ML algorithms and new analytics applications to support use cases for MDO

For more information about ATTENDS, including scheduling a demonstration of ATTENDS in action, contact info@peratonlabs.com.

