



## **ADIN Cluster, Unstructured Data, Bias Agents, and Quantum Computing**

ADIN is an intelligent system with autonomous agents framework upon which Echo has been building applications and solutions for more than 15 years. ADIN, which stands for Anomaly Detection and Intelligent Notification, started as an intelligent messaging system, and during the 2008 economic downturn pivoted into a smart delivery engine. Years of developing a dynamic agent-based framework, making the best use of A.I. techniques in machine learning and automation, led to ADIN and now to the ADIN Cluster. ADIN has been used in many applications involving asynchronous events in resource matching, data syncs, workflows and notification systems. We found that creating more and more reusable, configurable agents could be combined and recombined to solve more and more complex problems without adding more development time. A group of agents working to solve a problem using shared data sources and user interfaces is called an ADIN cell.

ADIN Agents are composed of adaptable constraints and actions. Adaptations can occur at all levels including ADIN cell, agents, triggering constraints, actions, models used by constraints, mappings to data sources and much more. Models used by agent constraints and actions are persistent objects that capture learned behavior and are modified via Machine Learning and Deep Learning algorithms. Agent parameters for constraints and actions are setup once and then process autonomously. Additional agents called 'Health Agents' are automatically paired to application agents and develop statistical distribution models to monitor and track normal trends, such as how often data is collected and how much data is collected. Health agents trigger when data falls outside the statistical model - where humans can be alerted (to perhaps a failing sensor) or agents can be cloned to increase needed bandwidth.

Up to now agent-based processing in ADIN has been limited to several hundred agents per ADIN Cell. In 2017, Echo introduced the concept of Agent Containers using Docker and Kubernetes. Agents run in their own execution environments and have access to greatly expanded processing resources orchestrated by Kubernetes, limited only by the hardware resources under its control. With the ADIN Cluster we are now able to push the number and complexity of agents even higher to tackle more complex problems such as Cognitive and Unstructured to Structured Data applications.

Unstructured to structured data problems are those involving vast amounts of unstructured data within which are hidden important data relationships. Climate change is an example where lots of data collected through various types of sensors. Data ranging from water temperature, status of glaciers, air pollution, animal land and sea migration patterns, weather patterns, tides, hurricanes, tornadoes and more can help bring into focus the true nature of climate change, to fully understand the inter-relationships between data so that we can make decisions to improve the Earth's health. In ADIN, hundreds of agents are configured to monitor many different open source (or propriety) data sets,

normalizing on location, date, time, sensor type, and any other information the data sets offer. Each agent gets Health Agents to monitor the quality of their results, and alerts to action if something abnormal happens.

Bias in data, models, and algorithms reflect bias in people and historically lead to inequities that are realized far downstream from the source. Data is the fuel upon which AI processes run, therefore bias-corrupted data sources and processes will lead to distorted and inaccurate results from automated systems. Correcting for bias is one of the areas that is a natural fit for ADIN, both to identify and mitigate the presence of all types of bias. Bias agents automatically monitor resulting structured data sets, where various types of bias agents each seek different types of bias that can occur including bias from incomplete datasets, or from the use of algorithms that result in skewed data that goes unchecked.

Model refinement is now being expanded to include Quantum Computing resources. An agent, for example, can have triggering criteria of detecting new water temperature data for detecting Global Warming across a large set of sensors in oceans. The model representing the distribution of sensors to the coverage area can refine the model to determine which sensors produce data that represents the best coverage over regions, thereby reducing the amount of data to process. With agents running in their own containers, these models can refine as new data triggers the update, including models being refined by Quantum Computing function such as Simulated Annealing by D-Wave, or enhanced searching of large unstructured data sources by Microsoft Quantum Computing and Google AI.

The ADIN Cluster is a set of hardware and software systems that together manage, maintain and deploy ADIN Cells solving a wide range of problems where the number of agents can increase from hundreds per ADIN Cell to thousands, tens of thousands or even more. An ADIN Controller server provides the main ADIN User Interface, along with the ADIN Dashboard and ADIN Rest API. ADIN Cluster servers provide the computing resources for independent execution environments of the agents.

A.I. is ubiquitous and continues to expand in influence and is now an integral part of medical, financial, legal, environmental, communication and transportation systems, among others. All aspects of human life are now touched by technology and therefore are touched by automation and A.I. methods. Getting automation right and knowing when it's wrong, so it can be corrected will increase the long-term value of automated systems.

Echo Messaging Systems has been quietly pushing forward on our ADIN platform to create the ADIN Cluster that offloads complexity to automation, such as gathering and normalizing unstructured data, seeking out and correcting bias, exploiting new computing resources in Quantum Computing for improved modeling of real-world system, and monitoring for anomalies when they happen to be ready to react, whether automated or human-based.

